UNIVERSITY OF DEBRECEN, FACULTY OF INFORMATICS

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BUSINESS INFORMATICS BSC

2025

Mode: Full-time training

Program Coordinator: Dr. Sándor Baran (baran.sandor@inf.unideb.hu)

Mentor: Dr. Henrietta Tomán (toman.henrietta@inf.unideb.hu)

Qualification requirements

General requirements of the diploma are regulated by The Rules and Regulations of The University of Debrecen.

Work and Fire Safety and Physical Education

The courses of „Work and Fire Safety" and „Physical Education" are worth 1 - 1 credit, which must be completed in excess of the number of credits required for the diploma as specified in the training and outcome requirements of the degree.

Diploma credit requirements

Natural Science:	39 credits
Human and Economic Knowledge:	36 credits
Compulsory topics:	66 credits
Differentiated knowledge topics:	42 credits
Professional Training:	12 credits
Thesis work:	15 credits
Free choise:	12 credits
Total:	**210 credits**
Work and Fire Safety:	1 credit
Physical Education (2 semesters)	2 credits

Professional training/Internship requirements

Professional training is a practice which is completed at a competent training place. It lasts for at least 8 weeks and 320 work hours.

It is a must to complete Professional training subject to issue the absolutorium (pre-degree certificate).

https://inf.unideb.hu/en/professional-training

Student can apply for Professional training after completing prerequisite subjects. Academic and Examination Rules and Regulations of the University of Debrecen contains those subjects.

Faculty of Informatics annex to the Academic and Examination Rules and Regulations of the University of Debrecen contains the procedure of the professional training.

The Thesis

During the studies, Student must write a thesis. Writing a thesis is a diploma requirement.

Thesis subject is mandatory to complete. The prerequisites to register for the Thesis subject are the followings:

- chose a thesis topic by the deadline.
  (Together with the supervisor the candidate writes a work plan in the maximum of two pages. The work plan describes the aim of the work, areas of expertise and the scheduling of the work.)
- the chosen topic is approved by the Educational Committee
- at least 100 completed credits.

Final Exam / State Exam

a., Requirements for Final Exam

1. Complete all the 210 credits required by the curriculum of program specialisation to have the degree of BSc program
2. Carry out the internship
3. Write and submit the Diploma Thesis

b., Process of the Final Exam

The Final Exam consists of an oral part only and the purpose is to examine the coherence of the professional knowledge.

F. The average from the grades of the oral exam (rounded to the nearest whole number) consists of an item of the Informatics and Natural Science Knowledge and an item of the Human and Economics Knowledge. If the grade for any item is failed, the grade is failed, and the final examination is failed.

D1. Thesis defence. During the defence the candidate has to sum up the Thesis in a short presentation then s/he answers the questions from the referee of the Thesis and the members of the Committee.

D2. The grade for the thesis, which is determined by the Final Examination Committee taking into account the grade proposed by the thesis assessor.

Calculation of the final examination grade (**ZV**): ZV = (F+D1+D2)/3

If the grade D2 is failed, the candidate will not be allowed to sit the final examination.

If any of the grades of F or D1 are unsatisfactory, the final exam is also unsatisfactory. Only the component graded as unsatisfactory must be retaken in the retake of the final examination.

Grade of Diploma:

Diploma grade: in the case of a successful final examination, it is determined based on the average of the following results:

a) **SZ**: average of the grades for the 'Thesis 2' subject, the grade for the examination of the thesis and the grades obtained for the defence of the thesis in the final examination, rounded to two decimal places

b) **F**: Average of the grades obtained in the final examination, rounded to a whole number

c) **T**: credit-weighted average to two decimal places of all compulsory and optional professional subjects completed during the course of training, except for the 'Thesis 2' subject weighted by credits, rounded to two decimal places.

Diploma grade = (SZ+F+T)/3

Based on the above average result, the qualification of the diploma is determined by the University of Debrecen's Academic and Examination Regulations, Section 31 (7).

The diploma shall be assessed based on the calculation of the grade average as follows:

outstanding	4,81-5,00
excellent	4,51-4,80
good	3,51-4,50
satisfactory	2,51-3,50
pass	2,00-2,50

Natural Science – needed 39 credits

Code	Subject name	Credit	Type and number			Assessment	Prerequisites	Period	Semester
			lec.	practice					
				sem.	lab				
INBGA0101-17 INBGA0101E INBGA0101G	Foundations of computer science	6	2	2		PM		1	1
INBGA0102-17 INBGA0102E INBGA0102G	Mathematics for business and economics 1	6	2	2		E S		1	1
INBGA0208-17 INBGA0208E INBGA0208G	Mathematics for business and economics 2	6	2	2		E S	INBGA0102-17	2	2
INBGA0313-17 INBGA0313E INBGA0313L	Statistics 1	6	2		2	PM	INBGA0208-17	1	3
INBGA0419-17 INBGA0419E INBGA0419L	Statistics 2	6	2		2	PM	INBGA0313-17	2	4
INBGA0420-17 INBGA0420E INBGA0420L	Numerical mathematics	6	2		2	PM	INBGA0208-17	2	4
INBGA0525-17 INBGA0525L	Operations research	3			2	PM	INBGA0208-17	1	5

Human and Economic Knowledge – needed 36 credits

Code	Subject name	Credit	Type and number			Assessment	Prerequisites	Period	Semester
			lec.	practice					
				sem.	lab				
INBGA0103-17 INBGA0103E	Introduction to management	3	2			E		1	1
INBGA0104-17 INBGA0104E	Fundamentals of business law	3	2			E		1	1
INBGA0209-17 INBGA0209E INBGA0209G	Microeconomics	6	2	2		E S		2	2
INBGA0210-17 INBGA0210E INBGA0210G	International financial accounting	6	2	2		E S		2	2
INBGA0314-17 INBGA0314E INBGA0314G	Macroeconomics	6	2	2		E S	INBGA0209-17	1	3
INBGA0315-17 INBGA0315E INBGA0315G	Introduction to finance	6	2	2		E S		1	3
INBGA0416-21 INBGA0416G	Organizational behaviour	3		2		PM		2	4
INBGA0527-21 INBGA0527G	Controlling	3		2		PM	INBGA0210-17 INBGA0315-17	1	5

Compulsory topics – needed 66 credits

Code	Subject name	Cre-dit	Type and number			Asses-ment	Prerequisites	Period	Semes-ter
			lec.	practice					
				sem.	lab				
INBGA0105-17 INBGA0105L	Introduction to programming	3			2	PM		1	1
INBGA0106-17 INBGA0106E INBGA0106L	Operating systems	6	2		2	PM		1	1
INBGA0107-17 INBGA0107E	Data management, copyright law	3	2			E		1	1
INBGA0211-17 INBGA0211E INBGA0211L	Data structures and algorithms	6	2		2	PM		2	2
INBGA0212-17 INBGA0212E INBGA0212L	Programming 1	6	2		2	PM	INBGA0105-17	2	2
INBGA0317-17 INBGA0317E INBGA0317L	Programming 2	6	2		2	PM	INBGA0212-17	1	3
INBGA0318-17 INBGA0318E INBGA0318L	Database systems	6	2		2	E S	INBGA0101-17	1	3
INBGA0422-21 INBGA0422E INBGA0422L	Information and knowledge management	6	2		2	E S		2	4
INBGA0423-17 INBGA0423E INBGA0423L	Data management	6	2		2	PM	INBGA0318-17	2	4
INBGA0424-17 INBGA0424L	Business intelligence in practice	3			2	PM		2	4
INBGA0528-17 INBGA0528L	Developing data handling programs	3			2	PM	INBGA0212-17 INBGA0318-17	1	5
INBGA0530-21 INBGA0530E INBGA0530L	Foundations of computer security	6	2		2	E S	INBGA0212-17	1	5
INBGA0545-25 INBGA0545E INBGA0545L	Foundations of artificial intelligence	6	2		2	PM	INBGA0101-17 INBGA0212-17	1	5

Thesis work – needed 15 credits

Code	Subject name	Cre-dit	Type and number			Asses-ment	Prerequisites	Period	Semes-ter
			lec.	practice					
				sem.	lab				
INBGA0631-21 INBGA0631X	Thesis 1	6				PM		2	6
INBGA0731-21 INBGA0731X	Thesis 2	9				PM		1	7

Differentiated knowledge topics – needed 42 credits

Code	Subject name	Credit	Type and number			Assessment	Prerequisites	Period	Semester
			lec.	practice					
				sem.	lab				
INBGA9926-21 INBGA9926E	World economy and economic integration	3	2			E		1	5
INBGA9929-25 INBGA9929E INBGA9929L	Fundamentals of software development and software testing	6	2		2	PM	INBGA0212-17	1	5
INBGA9932-17 INBGA9932E INBGA9932L	Financial mathematics	6	2		2	E S	INBGA0315-17	1	5
INBGA9933-17 INBGA9933L	Introduction to SAP - End user level	3			2	PM		1	5
INBGA9937-17 INBGA9937L	Computer statistics	3			2	PM	INBGA0419-17 INBGA0424-17	1	5
INBGA9921-21 INBGA9921E	Marketing	3	2			E		2	6
INBGA9934-17 INBGA9934L	Advanced spreadsheets	3			2	PM	INBGA0212-17	2	6
INBGA9935-17 INBGA9935E INBGA9935L	Big Data analysis	6	2		2	PM		2	6
INBGA9936-17 INBGA9936L	Data visualization	3			2	PM		2	6
INBGA9938-17 INBGA9938E INBGA9938G	Corporate finance	6	2	2		E S	INBGA0315-17	2	6
INBGA9939-17 INBGA9939E	Strategic management	3	2			E	INBGA0103-17	2	6
INBGA9940-17 INBGA9940L	Introduction to SAP - Developer level	3			2	PM		2	6
INBGA9941-17 INBGA9941E	International business	3	2			E		2	6
INBGA9942-17 INBGA9942L	Decision support systems	3			2	PM	INBGA0208-17	2	6
INBGA9947-17 INBGA9947EL	Fundamentals of Information and Coding Theory	3	2			E	INBGA0313-17	2	6
INBGA9949-17 INBGA9949L	Introducton to Cloud Technologies	3			2	PM	INBGA0212-17	2	6
INBGA9997-21 INBGA9997G	Professional Training	12				PM	INBGA0317-17 INBGA0210-17	I	6
INBGA9943-21 INBGA9943L	Advanced data security	3	2			E	INBGA0530-21	1	7
INBGA9944-17 INBGA9944L	Digital marketing	3			2	PM	INBGA9921-21	1	7
INBGA9946-17 INBGA9946E INBGA9946G	Management of value creating processes	6	2	2		E S	INBGA0103-17	1	7

Code	Subject name	Credit	Type and number			Assessment	Prerequisites	Period	Semester
			lec.	practice					
				sem.	lab				
INBGA9952-17 INBGA9952L	Ethical hacking I.	3			2	PM	INBGA0212-17	I	
INBGA9953-17 INBGA9953E	Blockhain technology	3	2			E		I	
INBGA9958-17 INBGA9958L	Introduction to the AWS Cloud	3			2	PM		I	
INBGA9959-21 INBGA9959L	Network and System Security	3			2	PM	INBGA0106-17	I	
INBGA9960-21 INBGA9960L	Ethical hacking 2.	3			2	PM	INBGA9952-17	I	
INBGA9961-21 INBGA9961L	DevSecOps	3			2	PM	INBGA0106-17	I	

Free choice – needed 12 credits

Code	Subject name	Credit	Type and number			Assessment	Prerequisites	Period	Semester
			lec.	practice					
				sem.	lab				

* "Free choice" - Professional electives offered by the Faculty of Informatics and institutional electives offered by other faculties of the University of Debrecen.

Work and Fire Safety and Physical Education – needed 3 credits

must be completed in excess of the number of credits required
for the diploma as specified in the training and outcome requirements of the degree

Code	Subject name	Credit	Type and number			Assessment	Prerequisites	Period	Semester
			lec.	practice					
				sem.	lab				
	Work and Fire Safety	1				PM			1
	Physical Education	1				PM			
	Physical Education	1				PM			

Exam types:
E exam
S signature
PM practical mark

BUSINESS INFORMATICS BSC

Description of Subjects

Natural Science

FOUNDATIONS OF COMPUTER SCIENCE

INBGA0101-17

Semester: 1
Type: Lecture / Seminar
Number of Classes: 2+2+0
Credit: 6
Status: Obligatory
Assessment: Practical mark
Prerequisites: None
Responsible: Dr. György Vaszil

Topics:
The syntax of propositional logic: logical connectives, subformulas. Semantics of propositional logic, truth-valuations, formula satisfiability, entailment. logical equivalence, logical laws. Binary decision diagrams. The syntax and semantics of predicate logic. Interpretations, truth values of formulas, satisfiability, logical laws, logical consequence. Formal languages: operations on languages, regular expressions, regular languages. Deterministic and nondeterministic finite automata. Languages recognized by finite automata, connection with regular languages. More general notions of computation: extensions of finite automata, Markov algorithm. Relating first order logic to programming languages: applications and perspectives.

Compulsory/Recommended Readings:
- Michael Sipser: Introduction to the Theory of Computation, 3rd ed., Cengage Learning, 2012.
- Mordechai Ben-Ari: Mathematical Logic for Computer Science, 3rd ed., Springer, 2012.

MATHEMATICS FOR BUSINESS AND ECONOMICS 1

INBGA0102-17

Semester: 1
Type: Lecture / Seminar
Number of Classes: 2+2+0
Credit: 6
Status: Obligatory
Assessment: Exam
Prerequisites: None
Responsible: Dr. Lajos Hajdu

Topics:
Basics of set theory and mathematical logic. Set of real numbers. Real sequences. Convergence, boundedness and monotonicity of sequences. Properties of convergent sequences. Fundamental sequences. Real series. Real functions, basic functions. Continuity and limit of real functions. Properties of continuous functions. Differentiable real functions. Examples and differentiability and algebraic operations. Mean value theorems of Cauchy, Lagrange and Rolle. L'Hospital's rule. Derivatives of higher order. Taylor series. Derivatives of higher order. Taylor series. Applications of derivatives: monotone, and convex functions, necessary condition of a local extremum, necessary and sufficient condition of a local extremum, necessary condition of monotonicity, necessary and sufficient condition of monotonicity, characterization of convexity. Two-variable functions, partial derivatives. Local extrema of two-variable functions. Indefinite integral: basic integrals, basic properties, linearity of indefinite integral. Basic rules and methods of indefinite integrals (integration by parts, integration with substitution). Examples. The notion of Riemann integrability and its probabilities. Applications of integration. Extension of integration: improper integral. The notion of double integral.

Compulsory/Recommended Readings:
- Knut Sydsaeter, Peter I. Hammond: Mathematics for Economic Analysis, Prentice-Hall, 1995.
- Serge Lang, A first course in calculus, Undergraduate Texts in Mathematics, Springer-Verlag, 2012.
- George B. Thomas Jr., Maurice D. Weir: Thomas' Calculus, Pearson Education, 2005.

MATHEMATICS FOR BUSINESS AND ECONOMICS 2

INBGA0208-17

Semester:	2
Type:	Lecture / Seminar
Number of Classes:	2+2+0
Credit:	6
Status:	Obligatory
Assessment:	Exam
Prerequisites:	INBGA0102-17 (Mathematics for Business and Economics 1)
Responsible:	Dr. Bernadett Aradi

Topics:
The k-dimensional real vector space. Linear dependence, basis, dimension. The rank of a vector system. Matrices, matrix calculus. Determinant and its properties, Leibnitz formula, relation to the rank. Matrices and systems of linear equations. Gaussian elimination. Solvability of systems of linear equations. Inverse of a matrix. Linear transforms and matrices. Symmetric and orthogonal matrices, eigenvalues, eigenvectors. Quadratic forms, definite forms. Sample space, events. Probability space, combinatorial probability, geometric probability. Conditional probability, independence, theorem of total probability. Bayes' theorem. Discrete and continuous random variables, cumulative distribution function, probability density function. Mean, standard deviation. Most important discrete distributions: binomial, hypergeometric, negative binomial, Poisson. Most important continuous distributions: uniform, exponential, normal. Joint distribution and independence of random variables. Covariance, correlation. Distribution characteristics: moments, skewness, kurtosis, mode, median, quantiles, variance-covariance matrix.

Compulsory/Recommended Readings:
- Knut Sydsaeter, Peter I. Hammond, Arne Storm: Mathematics for Economic Analysis. Pearson, 2012.
- Dimitri Bertsekas, John N. Tsitsiklis: Introduction to Probability, 2nd Edition, Athena, 2008.

STATISTICS 1

INBGA0313-17

Semester:	3
Type:	Lecture / Laboratory
Number of Classes:	2+0+2
Credit:	6
Status:	Obligatory
Assessment:	Practical mark
Prerequisites:	INBGA0208-17 (Mathematics for Business and Economics 2)
Responsible:	Dr. Erika Fülöp

Topics:
Fundamental notions of statistics, populations, levels of measurement. Simple methods of data analysis, fundamentals of data visualization. Statistical analysis of a population along a single variable. Statistical analysis along several variables. Heterogeneous populations. Types of relation between variables. Standardization, ratios, coefficients. Comparison of aggregates with the help of indices. Fundamentals of statistical data collection. Sampling methods. Point estimators and their properties. Methods of point estimation. Inequalities. Laws of large numbers. Central limit theorem. Fundamental distributions of statistics. Confidence intervals for a single sample. Two-sample confidence intervals
Fundamentals of hypothesis testing, one-sample z-test.

Compulsory/Recommended Readings:
- Anderson, D. R., Sweeney, D. J., Williams, T. A., Freeman, J. and Shoesmith, E.: Statistics for Business and Economics, Third edition, Cengage Learning EMEA, 2014.
- Montgomery, D. C. and Runger, G. C.: Applied Statistics and Probability for Engineers, Wiley, 2010.

STATISTICS 2

INBGA0419-17

Semester: 4
Type: Lecture / Laboratory
Number of Classes: 2+0+2
Credit: 6
Status: Obligatory
Assessment: Practical mark
Prerequisites: INBGA0313-17 (Statistics 1)
Responsible: Dr. Sándor Baran

Topics:
Parametric tests for a single sample. Chi-square tests: testing for goodness of fit, independence and homogenity. Parametric tests for two samples. One-way analysis of variance. Nonparametric tests. Kolmogorov-Smirnov tests, Kruskal-Wallis H test. Simple linear regression. Nonlinear models. Multiple linear regression. Parameter estimation in regression models. Hypothesis tests in regression models. Model adequacy checking. Fundamentals of time series analysis. Trend estimation by regression. Moving average filtering, smoothing methods. Estimation of seasonal variation.

Compulsory/Recommended Readings:
- Anderson, D. R., Sweeney, D. J., Williams, T. A., Freeman, J. and Shoesmith, E.: Statistics for Business and Economics, Third edition, Cengage Learning EMEA, 2014.
- Montgomery, D. C. and Runger, G. C.: Applied Statistics and Probability for Engineers, Wiley, 2010.

NUMERICAL MATHEMATICS

INBGA0420-17

Semester:	4
Type:	Lecture / Laboratory
Number of Classes:	2+0+2
Credit:	6
Status:	Obligatory
Assessment:	Practical mark
Prerequisites:	INBGA0208-17 (Mathematics for Business and Economics 2)
Responsible:	Dr. Ágnes Éva Baran

Topics:
Floating point arithmetic, errors. Condition numbers of matricies, numerical solution of system of linear equations. Least square approximations, interpolation. Numerical integration. Numerical solution of nonlinear equations and system of nonlinear equations. Minimization of functions.

Compulsory/Recommended Readings:
- Gisbert Stoyan, Agnes Baran, Elementary Numerical Mathematics for Programmers and Engineers, Birkhäuser, 2016, ISBN 978-3-319-44659-2
- W.H. Press, S. A. Teukolsky, W. T. Vetterling, B. P. Flannery, Numerical Recipes, Cambridge UP, 2007, ISBN 978-0-521-88407-5

OPERATIONS RESEARCH

INBGA0525-17

Semester:	5
Type:	Laboratory
Number of Classes:	0+0+2
Credit:	3
Status:	Obligatory
Assessment:	Practical mark
Prerequisites:	INBGA0208-17 (Mathematics for Business and Economics 2)
Responsible:	Dr. Anett Rácz

Topics:
Examples for Linear Programming (LP) problems, types of LP problems. Graphical solution of LP problems. Overview of optimization solvers. Simplex method. Two-Phase Simplex method. Big-M method. Integer Programming. Duality. Sensitivity analysis. Transportation problems. Assignment problems, Hungarian method. Case studies.

Compulsory/Recommended Readings:
- Wayne L. Winston: Operations research, Methods and applications, Thomson Brooks/Cole, 2004.
- A. Ravi Ravindran: Operations Research and Management Science Handbook, CRC Press, 2008.

INTRODUCTION TO MANAGEMENT

INBGA0103-17

Semester: 1
Type: Lecture
Number of Classes: 2+0+0
Credit: 3
Status: Obligatory
Assessment: Exam
Prerequisites: None
Responsible: Dr. Adrián Szilárd Nagy

Topics:
Students will become familiar with the general management tasks such as planning, organization, human resources management, incentive, control. The course is also responsible to provide students with the concept, grouping them basic economic knowledge, management of the value creation for businesses. Students have to be taught the main elements of stock and flow process, value creation procedure, life cycle theory, basic elements of business planning.

Compulsory/Recommended Readings:
- Richard Pettinger: Introduction to Management, 4th edition, Palgrave Macmillan, 2006.
- Andy Schmitz: Principles of Managerial Economics, Lardbucket Books, 2013.

FUNDAMENTALS OF BUSINESS LAW

INBGA0104-17

Semester: 1
Type: Lecture
Number of Classes: 2+0+0
Credit: 3
Status: Obligatory
Assessment: Exam
Prerequisites: None
Responsible: Dr. Géza Károlyi

Topics:
Legal concepts, the structure of the legal system, The system of state agencies, The subject of economic activity (legal capacity of legal entities), The business activity of a natural person, Common rules for companies. The founding of companies, The organizational structure of companies, A general partnership and limited partnership features, The limited liability company, The features of incorporated companies, the securities law characteristics of shares, Other legal persons organizations (cooperatives, NGOs), Termination of companies without succession and succession, Types and Characteristics The procedures insolvency, Property law, acquisition of property, The general rules of civil law contracts.

Compulsory/Recommended Readings:
- Twigg-Flesner, Christian: The Cambridge Companion to European Union Private Law, Cambridge University Press, Cambridge, 2010.
- Ewan Macintyre: Business Law, Pearson Education Limited, 2010. ISBN: 978-1-4082-3797-7

MICROECONOMICS

INBGA0209-17

Semester: 2
Type: Lecture / Seminar
Number of Classes: 2+2+0
Credit: 6
Status: Obligatory
Assessment: Exam
Prerequisites: None
Responsible: Dr. Andrea Karcagi-Kováts

Topics:
Principles of microeconomics, equilibrium analysis – graphical treatment. Price elasticity and other elasticities. Utility and preferences. Budget constraint. Consumer choice. Individual and market demand. Production functions and the returns to scale. Cost functions. Cost-minimization. Competitive market. Monopoly. Welfare effects of monopoly.

Compulsory/Recommended Readings:
- Besanko, David – Breautigam, Ronald R.: Microeconomics. Third Edition (International Student version). John Wiley and Sons, Inc., New York, 2008.
- Besanko, David – Breautigam, Ronald R.: Microeconomics. Study Guide. Third Edition. John Wiley and Sons, Inc., New York, 2008.

INTERNATIONAL FINANCIAL ACCOUNTING

INBGA0210-17

Semester: 2
Type: Lecture / Seminar
Number of Classes: 2+2+0
Credit: 6
Status: Obligatory
Assessment: Exam
Prerequisites: None
Responsible: Dr. Andrea Szabó

Topics:
Fundamentals of financial accounting, principles. Basic financial statements: statement of financial position, statement of profit or loss, statement of cash flows. Introduction to International Accounting Standards/International Financial Reporting Standards, the IASB's Conceptual Framework. The structure and governance of IFRS Foundation. The double-entry bookkeeping system. Journals, journalizing and posting transactions, adjusting and closing procedures. The accounting and bookkeeping cycle, the trial balance, preparing financial statements. The contents of financial statements, statement of financial position, comprehensive income (CI) other comprehensive income (OCI). Statement of changes in equity (SOCIE), notes to the financial statements, and other general disclosure requirements. Events after the reporting period, accounting policies. Earnings per Share. Operating Segments. Non-current Assets Held for Sale and Discontinued Operations. Financial reporting issues, recognition of assets and liabilities. Revenue from contracts with customers. Measurement of the elements of financial statements. Accounting for property, plant and equipment: recognition and initial measurement. Depreciation of cost of assets. Measurement subsequent to initial recognition. Investment properties. Impairment of assets. Leases. Intangible assets. Inventories, counting inventory. Valuation of inventory. Financial instruments. Financial assets. Fair value measurement. Financial liabilities. Equity, reserves and provisions. Foreign currency translation.

Compulsory/Recommended Readings:
- David Alexander, Christopher Nobes: Financial Accounting: An International Introduction, 6th Edition, Prentice Hall, 2016.
- Clyde P. Stickney, Roman L. Weil, Katherine Schipper, Jennifer Francis: Financial Accounting: An Introduction to Concepts, Methods and Uses, South-Western Cengage Learning, 2010.
- Barry J. Epstein, Eva K. Jermakowicz: Wiley IFRS: Interpretation and Application of International Accounting and Financial Reporting Standards 2010, Wiley, 2010.
- Thomas R. Ittelson: Financial Statements: A Step-by-Step Guide to Understanding and Creating Financial Reports, Career Press, 2010.

MACROECONOMICS

INBGA0314-17

Semester: 3
Type: Lecture / Seminar
Number of Classes: 2+2+0
Credit: 6
Status: Obligatory
Assessment: Exam
Prerequisites: INBGA0209-17 (Microeconomics)
Responsible: Dr. Pál Czeglédi

Topics:
The fundamental questions of macroeconomics. Principles of measuring macroeconomic aggregates. The economy in the long run: equilibrium on the market for goods and services and on the market for loanable funds. Equilibrium on the market for factors of production and the theory of income distribution. Natural unemployment. Functions of money, and the money supply. The quantity theory of money, and the demand for money. Inflation and its social costs. The Keynesian cross. The IS-LM model. Applications of the IS-LM model. Aggregate demand and aggregate supply. The Phillips curve. Friedman's and Modigliani's hypothesis about the consumption function.

Compulsory/Recommended Readings:
- Mankiw, G.: Macroeconomics. Sixth Edition. Worth Publisher, New York, 2007.
- Kaufman, R. T.: Student Guide and Workbook for Use with Macroeconomics. Worth Publisher, New York, 2007.

INTRODUCTION TO FINANCE

INBGA0315-17

Semester: 3
Type: Lecture / Seminar
Number of Classes: 2+2+0
Credit: 6
Status: Obligatory
Assessment: Exam
Prerequisites: None
Responsible: Dr. József Mihály Gáll

Topics:
The course gives an introduction to finance and financial markets, to the principle of time value of money, the valuation methods based on PV, and some other basic financial tools, e.g. financial ratios derived from the financial statements.

Compulsory/Recommended Readings:
- Brealey R. and Myers S.: Principles of Corporate Finance, 11th Global Edition, McGraw-Hill, 2013.
- Hull, J. C.: Options, Futures and Other Derivatives, 10th edition, Pearson, 2015.

ORGANIZATIONAL BEHAVIOUR

INBGA0416-21

Semester: 4
Type: Seminar
Number of Classes: 0+2+0
Credit: 3
Status: Obligatory
Assessment: Practical mark
Prerequisites: None
Responsible: Dr. Mária Ujhelyi

Topics:
Introduction to Organizational Behaviour. Workplace Diversity, Job Attitudes. Values and Personality. Perception and Decision Processes. Motivating Others: Basics of Motivation, Applied Motivation. From Groups to Teams. Key Group Concepts. Leadership and Trust. Power and Organizational Politics. Conflict in Organizations. Organizational Design. Creating and Sustaining Culture. Managing Change.

Compulsory/Recommended Readings:
- Robbins, Stephen P. – Judge, Timothy A.: Essentials of Organizational Behavior, 13th edition, global edition, Pearson Education Limited, Harlow, 2016.
- Janasz, Susanne C. – Down, Karen O. – Schneider, Beth Z.: Interpersonal Skills in Organizations, McGraw Hill New York, 2002.

CONTROLLING

INBGA0527-21

Semester:	5
Type:	Seminar
Number of Classes:	0+2+0
Credit:	3
Status:	Obligatory
Assessment:	Practical mark
Prerequisites:	INBGA0210-17 (International financial accounting) and INBGA0315-17 (Introduction to finance)
Responsible:	Dr. Vilmos Lakatos

Topics:
Introduction, basic requirements. The nature of management control systems. Behaviour in organizations. Introduction to responsibility centers. Revenue centers. Expense centers. Profit centers. Transfer pricing. Measuring and controlling assets employed. Strategic planning. Budget preparation. Analysing financial performance. Performance measurement.

Compulsory/Recommended Readings:
- V. Govindarajan: Management Control Systems, McGraw-Hill/Irwin, 12th Edition, New York, NY, 2007.
- Flamholtz, E.G.: Effective Management Control, Kluwer Academic Publishers, 1996.
- Merchant, K.-Van der Stede, W.: Management Control Systems, Performance Measurement, Evaluation and Incentives, Prentice Hall, 2007.

Compulsory Topics

INTRODUCTION TO PROGRAMMING

INBGA0105-17

Semester: 1
Type: Laboratory
Number of Classes: 0+0+2
Credit: 3
Status: Obligatory
Assessment: Practical mark
Prerequisites: None
Responsible: Dr. Szilvia Szeghalmy

Topics:
Basic concepts of programming. Source code writing, compiling/linking, running. Getting to know one IDE. Usage of constants and variables. Types, arithemetical, logical and comparing operators. Standard I/O handling. Controlling structures. Basics of string handling. Introduction into subprograms. Usage of some data structure. Getting to know an algorithm descriptor tool. Implementing basic algorithms (e.g.: summarizing, counting, searching) and solving problems based on these algorithms.

Compulsory/Recommended Readings:
- Summerfield, Mark: Programming in Python 3: A Complete Introduction to the Python Language, Addison-Wesley Professional; 2nd edition, 2009.
- Downey, Allen B. Think Python - How to Think Like a Computer Scientist, O'Reilly Media, 2012, ISBN: 9781449330729

OPERATING SYSTEMS

INBGA0106-17

Semester: 1
Type: Lecture / Laboratory
Number of Classes: 2+0+2
Credit: 6
Status: Obligatory
Assessment: Practical mark
Prerequisites: None
Responsible: Dr. Zoltán Attila Godó

Topics:
Concepts, tasks, and components of an operating system. Classification of the operating systems. Historical overview. Hardware, architectures. Operating systems network management. Testing commands. Files and file systems. Special files under Unix. Redirection. Unix file systems. Process management. Signals. Priority, priority handling. Scheduling. Disk handling. NAS and SAN. Security. Virtualization. Cloud computing. Mobile operating systems.

Compulsory/Recommended Readings:
- Silbershatz, Galvin: Operating system concepts, 9th edition, John Wiley & Sons, Inc., 2012.
- ISBN 978-1-118-06333-0
- Andrews, Jean: A+ Guide to IT Technical Support (Hardware and Software),9th edition, Course Technology, 2016.
- Garrido, Jose: Principles of Modern Operating Systems, 2nd edition, Jones & Bartlett Learning, 2011.

DATA MANAGEMENT, COPYRIGHT LAW

INBGA0107-17

Semester: 1
Type: Lecture
Number of Classes: 2+0+0
Credit: 3
Status: Obligatory
Assessment: Exam
Prerequisites: None
Responsible: Dr. Tamás Fézer

Topics:
The course covers two important areas of IT law. Under the data management part, we discuss purposes and subjects of data management, the most important principles and legal requirements data management activities and data managers must meet, while the new Data Protection Regulation of the European Union is also thoroughly analyzed. Case law of the European Court of Justice and some data protection authorities in EU Member States is also used to interpret and make the practical use of the norms understood.
The other part of the course focuses on copyright law and its basic principles as set by the most relevant international treaties and conventions to find the common cores of the area. Copyright law classes put a significant emphasis on the protection of artistic property in a digital environment.

Compulsory/Recommended Readings:
- Linder, Andreas (ed.): European Data Protection Law: General Data Regulation, Cre-ateSpace Publishing, 2016. ISBN-978-1533170835
- Stamatoudi, Irini – Torremans, Paul (eds.): EU Copyright Law – A Commentary, Edward Elgar Publishing, 2014. ISBN-978-1781952429
- Lewinski, Silke von: International Copyright Law and Policy, Oxford University Press, 2008. ISBN-978-0199207206

DATA STRUCTURES AND ALGORITHMS

INBGA0211-17

Semester: 2
Type: Lecture / Laboratory
Number of Classes: 2+0+2
Credit: 6
Status: Obligatory
Assessment: Practical mark
Prerequisites: None
Responsible: Dr. Géza Horváth

Topics:
The course covers commonly used data structures, the algorithms necessary to manipulate them, and introduces the basic concepts of algorithmic complexity. Topics include elementary data structures, searching, sorting; hash tables, trees, graphs; time complexity, parallel algorithms basics.

Compulsory/Recommended Readings:
- Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein: Introduction to Algorithms. Third Edition. The MIT Press, Cambridge, Massachusetts London, England, 2009.
- Donald E. Knuth: The Art of Computer Programming, volume 1. Third edition, Addison-Wesley, 1997.
- Donald E. Knuth: The Art of Computer Programming, volume 3. Second edition, Addison-Wesley, 1998.
- Seymour Lipschutz: Data Structures, McGraw-Hill, 2014.

PROGRAMMING 1

INBGA0212-17

Semester: 2
Type: Lecture / Laboratory
Number of Classes: 2+0+2
Credit: 6
Status: Obligatory
Assessment: Practical mark
Prerequisites: INBGA0105-17 (Introduction to programming)
Responsible: Dr. Gábor József Halász

Topics:
Evolution of programming languages and how to group them. Basic concepts (semantics, syntax, compiling, linking, etc.). Getting familiar with popular programming environments. Character set, lexical unit, how to edit source code. Data types. Named constants and variables. Expressions, expression evaluation. Declarations and executable statements. Assignment and empty statements. Control Structures. Subprograms. Evaluation of parameters and parameter passing. Further program units. Scope management, visibility. I / O, file management. Exception handling. Problem modeling based on procedure-oriented approach. BPMN diagram. Tools of functional programming, lambda expressions. Practice: file management, processing command line arguments, basics of exception handling, using different data structures, numerical calculations and data visualization tools, lambda expressions.

Compulsory/Recommended Readings:
- Summerfield, Mark: Programming in Python 3: A Complete Introduction to the Python Language, Addison-Wesley Professional; 2nd edition, 2009.
- Downey, Allen B. Think Python - How to Think Like a Computer Scientist, O'Reilly Media, 2012, ISBN: 9781449330729

PROGRAMMING 2

INBGA0317-17

Semester: 3
Type: Lecture / Laboratory
Number of Classes: 2+0+2
Credit: 6
Status: Obligatory
Assessment: Practical mark
Prerequisites: INBGA0212-17 (Programming 1)
Responsible: Dr. Gábor József Halász

Topics:
Concepts of OO paradigm. Encapsulation, class, object, data members, methods, getters / setters. Constructors, destructors, initialization functions, instantiation. Inheritance, polymorphism, static and dynamic binding, visibility levels. Operator overloading. Multiple inheritance, abstract classes, inner classes. Interfaces, collections. OO design process, heuristics. UML diagrams (use case, class diagram). Modelling problems based on OO approach. Text analysis and text mining in business applications. Web text mining. Exercise: getting to know the OO capabilities of a programming language. Analyzing text documents, regular expressions.

Compulsory/Recommended Readings:
- Summerfield, Mark: Programming in Python 3: A Complete Introduction to the Python Language, Addison-Wesley Professional; 2nd edition, 2009.
- Downey, Allen B. Think Python - How to Think Like a Computer Scientist, O'Reilly Media, 2012, ISBN: 9781449330729
- Bird, S., Klein, E., Loper, E.: Natural Language Processing with Python, O'Reilly Media, 2009.

DATABASE SYSTEMS

INBGA0318-17

Semester:	3
Type:	Lecture / Laboratory
Number of Classes:	2+0+2
Credit:	6
Status:	Obligatory
Assessment:	Exam
Prerequisites:	INBGA0101-17 (Foundations of computer science)
Responsible:	Dr. Marianna Zichar, Bodroginé

Topics:
Data modeling using entity-relationship (ER) model (entity types, attributes, relationship types, key attributes). Relational data model (relation, relational database schema, attributes, and constraints). Relational database design using ER-to-relational mapping. Relational algebra operations. Functional dependency. Normal forms, the process of normalization. Structure of database management systems. Enhanced ER model (EER) and its mapping to relations. Transaction processing, grant revoking and concurrency control. Database security. Data warehouses, fundamentals of data mining. NoSQL databases.

Compulsory/Recommended Readings:
- Ramez Elmasri, Shamkant B. Navathe: Fundamentals of Database Systems (7th Edition), Pearson, 2015, ISBN 9780136086208
- Jeffrey D. Ullman, Jennifer Widom: First A First Course in Database Systems, Pearson Prentice Hall, 2008, ISBN 9780136006374

INFORMATION AND KNOWLEDGE MANAGEMENT

INBGA0422-21

Semester: 4
Type: Lecture / Laboratory
Number of Classes: 2+0+2
Credit: 6
Status: Obligatory
Assessment: Exam
Prerequisites: None
Responsible: Dr. Erzsébet Tóth

Topics:
Information society. Products like services. e-business. Electronic marketplaces. Confidence in e-markets. e-marketing. Transformation of the company's operations and organization in the information economy. Employee in information economy. New type of consumer.
Process management. Increase process performance. Process analysis and modeling. Process controlling. Process modeling software. IT solutions for the process cost management.
Performance Management Concepts. Human resource management.
Knowledge management in corporate practice. Customer management, customer relationship management.

Compulsory/Recommended Readings:
- Davenport, Thomas H., Prusak, Laurence: Working Knowledge: How Organizations Manage what They Know, Harvard Business School Press, 2000. ISBN- 0 87584 655 6,
- Castells, M,: The information age: economy, society and culture, Malden ; Oxford : Blackwell Publishers, 1998.
- Castells, M,: The Internet Galaxy, Oxford University Press, 2002. ISBN-0 1992 5577 6
- Ghoshal, S., Bartlett, C.A,: Random House, 2012. ISBN-1446494527

DATA MANAGEMENT

INBGA0423-17

Semester: 4
Type: Lecture / Laboratory
Number of Classes: 2+0+2
Credit: 6
Status: Obligatory
Assessment: Practical mark
Prerequisites: INBGA0318-17 (Database systems)
Responsible: Dr. Marianna Zichar, Bodroginé

Topics:
Becoming familiar with the structure of database management system selected to study in the current semester. Metadata management (planning and implementation of easy access to integrated metadata of high quality). Data-centered activities in software development life cycle (SDLC): analysis and planning of data requirement, maintaining the database, solution components related to data). Database accessibility, levels of service. Database administration, tasks of database administrators. The role of indexes, indexing. Data quality management. Database monitoring, technologies of backup, recovery, and tuning. Log management. Current industrial trends and their impacts.

Compulsory/Recommended Readings:
- Mullins: Database Administration, Addison-Wesley, 2013, ISBN 978-0201741292
- Keith Gordon: Principles of Data Management, BCS, The Chartered Institute for IT, 2013, ISBN 9781780171845

BUSINESS INTELLIGENCE IN PRACTICE

INBGA0424-17

Semester: 4
Type: Laboratory
Number of Classes: 0+0+2
Credit: 3
Status: Obligatory
Assessment: Practical mark
Prerequisites: None
Responsible: Dr. Sándor Pecsora

Topics:
Creating simple queries, summarized output, using prompts in tasks and queries. Introducing SAS Enterprise Guide, understanding SAS Data structure. Accessing SAS Data and knowing the possibilities of publication of results. Introduction Tasks. Creating fundamental queries: filtering and sorting data, grouping and summarizing data in a query. Joining tables, creating new columns with an expression. Using Prompts in tasks and queries. Creating a graph and investigating the practical application of graphs. Creating a Bar chart and investigating the practical application of bar chart. Creating summary statistics. Creating a summary report with the summary tables task. Customizing and organizing project results: combining results, updating and organizing projects. Insight to Visual Analytics.

Compulsory/Recommended Readings:
- Olivia Parr-Rud: Business Analytics Using SAS Enterprise Guide and SAS Enterprise Miner: A Beginner's Guide, SAS Institute, 2014. ISBN 978-1-61290-783-3
- Gert H. N. Laursen, Jesper Thorlund: Business Analytics for Managers: Taking Business Intelligence Beyond Reporting, 2nd edition, John Wiley Sons Inc., 2016. ISBN 978-1-11929-858-8
- Thomas Davenport, Jeanne G. Harris, Robert Morison: Analytics at Work: Smarter Decisions, Better Results, Harvard Business Review Press, 2010. ISBN 978-1-42217-769-3

DEVELOPING DATA HANDLING PROGRAMS

INBGA0528-17

Semester:	5
Type:	Laboratory
Number of Classes:	0+0+2
Credit:	3
Status:	Obligatory
Assessment:	Practical mark
Prerequisites:	INBGA0212-17 (Programming 1) and INBGA0318-17 (Database systems)
Responsible:	Dr. Marianna Zichar, Bodroginé

Topics:
CSV and JSON document management. Data extraction from XLS(X) documents. Manipulation of XLS(X) documents. Create and manage database connections. Use cursors, execution of queries and data modification operations. Create data tables. Data exchange between database and spreadsheet systems. Application development building on the obtained knowledge.

Compulsory/Recommended Readings:
- Jeffrey D. Ullman, Jennifer Widom: First A First Course in Database Systems, Pearson Prentice Hall, 2008, ISBN 9780136006374
- Lukaszewski, Albert: MySQL for Python, Pact Publishing, 2010.

FOUNDATIONS OF COMPUTER SECURITY

INBGA0530-21

Semester: 5
Type: Lecture / Laboratory
Number of Classes: 2+0+2
Credit: 6
Status: Obligatory
Assessment: Exam
Prerequisites: INBGA0212-17 (Programming 1)
Responsible: Dr. Andrea Pintér-Huszti

Topics:
Computer security concepts. The CIA traid. A model for Computer Security: assets, threats, risk, countermeasures. Common threats. Physical and infrastructure security. Roles and responsibilities, legal and ethical aspects. Malicious software, DOS, firewalls. Encryption schemes, OTP, DES, 3DES, AES, RSA. Digital signatures, PKI, Identification, authentication, authorization. The SSL/TLS protocol.

Compulsory/Recommended Readings:
- William Stallings: Computer Security, Principles and Practice, 3rd edition, 2015. ISBN-13: 978-0133773927
- Douglas R. Stinson: Cryptography Theory and Practice, 3rd edition, Chapman & Hall/CRC, 2006, ISBN-13 978-1-58488-508-5.

FOUNDATIONS OF ARTIFICIAL INTELLIGENCE

INBGA0545-25

Semester:	5
Type:	Lecture / Laboratory
Number of Classes:	2+0+2
Credit:	6
Status:	Obligatory
Assessment:	Practical mark
Prerequisites:	INBGA0101-17 (Foundations of Computer Science) and INBGA0212-17 (Programming 1)
Responsible:	Dr. Balázs Harangi

Topics:
Problem representations, state-space representation, state-space graph, examples. Uninformed systematic search in state-space graphs. Heuristic search strategies. Constraint satisfaction problems. Two-player games, representation of the game, game tree. Winning strategy. Min-max procedure, the alpha-beta pruning procedure. Knowledge representation: categories, objects, actions, situations, events, reasoning. Probabilistic reasoning (Bayesian networks). Tools of machine learning: learning from examples, statistical learning, perceptrons, neural networks, deep learning

Compulsory/Recommended Readings:
- Pedro Domingos: The Master Algorithm, Basic Books; 1 edition, 2015
- Peter Norvig, Stuart J. Russell: Artificial Intelligence: A Modern Approach, 3rd edition, Pearson Education Limited, 2013. ISBN 1292024208

Differentiated knowledge topics

WORLD ECONOMY AND ECONOMIC INTEGRATION

INBGA9926-21

Semester: 5
Type: Lecture
Number of Classes: 2+0+0
Credit: 3
Status: Optional
Assessment: Exam
Prerequisites: None
Responsible: Dr. László Erdey

Topics:
The Historical Development of Capitalism. Population. Resources and Environment. Agriculture. Manufacturing. Services. Cities and Urban Economies. Consumption. Transportation and Communication. The Contracts of the European Union. EU Institutions and decision making. EU Internal Market. EU Economic and Monetary Union. The most important policies of the EU.

Compulsory/Recommended Readings:
- Stutz, Frederick P., Warf, Barney: The World Economy, Pearson New International Edition (6th), 2014. ISBN 13: 978-1-292-02119-5
- Fairhurst, John: Law of the European Union, 11th Edition, Pearson, 2016. ISBN13: 9781292090337

FUNDAMENTALS OF SOFTWARE DEVELOPEMENT AND SOFTWARE TESTING

INBGA9929-25

Semester: 5
Type: Lecture / Laboratory
Number of Classes: 2+0+2
Credit: 6
Status: Optional
Assessment: Practical mark
Prerequisites: INBGA0212-17 (Programming 1)
Responsible: Dr. Gergely Kocsis

Topics:
By this class the student are introduced to the basics of architectural design, the methodologies of software development, the basics of requirement engineering and the basics of software testing and to the role of these topics. The students will know their place in the system development process and will be able to contribute in them. They will understand the methods and will be able to apply them.

Compulsory/Recommended Readings:
- Dorothy Graham, Erik van Veenendaal, Isabel Evans, Rex Black: Foundations of Software Testing: ISTQB Certification, Cengage Learning India; 3rd edition, 2013.
- Ian Sommerville: Software Engineering, 10th Edition, Pearson, 2015.
- Andrew Stellman, Jennifer Greene: Learning Agile: Understanding Scrum, XP, Lean, and Kanban, O'Reilly Media, 2013.
- Klaus Pohl, Chris Rupp: Requirements Engineering Fundamentals, Rocky Nook Inc.2015
- Lisa Crispin, Janet Gregory: Agile Testing: A Practical Guide for Testers and Agile Teams, Addison-Wesley Professional; 1st edition, 2009.

FINANCIAL MATHEMATICS

INBGA9932-17

Semester: 5
Type: Lecture / Laboratory
Number of Classes: 2+0+2
Credit: 6
Status: Optional
Assessment: Exam
Prerequisites: INBGA0315-17 (Introduction to finance)
Responsible: Dr. Erika Fülöp

Topics:
To give an introduction to derivative pricing and modern risk management. Definitions of derivatives, classification. Option markets, positions using financial assets. Basic properties of options prices. (early call, put-call parity). Strategies using options. Pricing in binary trees. One step model. Models for stock price in continuous models. The basics of Black-Scholes market. Black-Scholes formula, related questions. Hedgind market risk. Estimating options prices. Value at Risk.

Compulsory/Recommended Readings:
- Hull, J. C.: Options, Futures and Other Derivatives, 10th edition, Pearson, 2015.
- Brealey R. and Myers S.: Principles of Corporate Finance, 11th Global Edition, McGraw-Hill, 2013.

INTRODUCTION TO SAP – END USER LEVEL

INBGA9933-17

Semester: 5
Type: Laboratory
Number of Classes: 0+0+2
Credit: 3
Status: Optional
Assessment: Practical mark
Prerequisites: None
Responsible: Dr. Anett Rácz

Topics:
Installing, and initial settings of the SAP system. Structure of the user interface. System messages. Navigating insode the SAP system, transaction codes, menus, icons, special functions. Personalizing the user interface, creating user definied menu, setting default values, installing printers. Mail system of SAP, setting workflow mails. SAP calendar. Create, save, print, export standard reports. Manage customer data, listing, modifications, inserting new records. Introduction into billing processes: create, modify, delete invoice. Orders: Take, modify, delete orders. Introduction into FI modul. Case studies.

Compulsory/Recommended Readings:

- Hernandez, J. A.,Keogh, J., Martinez, F. F.: SAP R/3, Panem, 2006.
- • Moxon, P.: The Beginner's Guide to SAP, SAPPROUK, 2014.

COMPUTER STATISTICS

INBGA9937-17

Semester:	5
Type:	Laboratory
Number of Classes:	0+0+2
Credit:	3
Status:	Optional
Assessment:	Practical mark
Prerequisites:	INBGA0419-17 (Statistics 2) and INBGA0424-17 (Business intelligence in practice)
Responsible:	Dr. Patrícia Ágnes Szokol

Topics:
Solution of statistical problems, statistical data analysis, describing of database with the help of a statistical software. Basic concepts of statistics, descriptive statistics. Data visualization, graphical methods. One- and two-sample parametric tests. Case studies. Chi-square tests: testing for goodness of fit, independence and homogenity. Nonparametric tests. Case studies. Analysis of Variance: One-way ANOVA. Analysis of Variance: Two-way ANOVA. Regression analysis, bivariate and multivariate linear models. Automated model buliding (forward, backward and stepwise methods). The use of discrete values, model adequacy checking. Log-linear models. Fundamentals of time series analysis, trend estimation by regression, moving average methods Stochastic time series models. Case studies.

Compulsory/Recommended Readings:
- Anderson, D. R., Sweeney, D. J., Williams, T. A., Freeman, J. and Shoesmith, E.: Statistics for Business and Economics, Third edition, Cengage Learning EMEA, 2014.
- James B. Davis: Statistics Using SAS Enterprise Guide, SAS Institute, 2007, ISBN 978-1-59047-566-9.
- Lee, C.-F., Lee, J.C., Chang, J.-R., Tai, T.: Essentials of Excel, Excel VBA, SAS and Minitab for Statistical and Financial Analyses, 2016, Springer, ISBN 978-3-319-38867-0
- Everitt, B.S., Hothorn, T.: A Handbook of Statistical Analysis Using R, Chapman & Hall, 2014.

MARKETING

INBGA9921-21

Semester: 6
Type: Lecture
Number of Classes: 2+0+0
Credit: 3
Status: Optional
Assessment: Exam
Prerequisites: None
Responsible: Dr. Zoltán Szakály

Topics:
Marketing: Creating and Capturing Customer Value. Company and Marketing Strategy: Partnering to Build Customer Relationships. Analyzing the Marketing Environment. Managing Marketing Information to Gain Customer Insights. Consumer Markets and Consumer Buyer Behavior. Business Markets and Business Buyer Behavior. Customer-Driven Marketing Strategy: Creating Value for Target Customers. Product, Services, and Brands: Building Customer Value. New-Product Development and Product Life-Cycle Strategies. Pricing: Understanding and Capturing Customer Value. Pricing Strategies: Additional Considerations. Marketing Channels: Delivering Customer Value. Retailing and Wholesaling. Communicating Customer Value: Integrated Marketing Communications Strategy. Advertising and Public Relations. Personal Selling and Sales Promotion. Direct and Online Marketing: Building Direct Customer Relationship. Creating Competitive Advantage. The Global Marketplace.

Compulsory/Recommended Readings:
- Kotler, P., Armstrong, G.: Principles of Marketing with MyMarketingLab: Global Edition, 16/E, Pearson, 2016. ISBN-10: 1292092599, ISBN-13: 9781292092591
- Kotler, P., Keller, K. L.: Marketing Management. 14th edition, Pearson/Prentice Hall, Boston, 2012.

ADVANCED SPREADSHEETS

INBGA9934-17

Semester: 6
Type: Laboratory
Number of Classes: 0+0+2
Credit: 3
Status: Optional
Assessment: Practical mark
Prerequisites: INBGA0212-17 (Programming 1)
Responsible: Dr. Balázs Harangi

Topics:
Definition of macros, recording and applying of them. Different levels of data protection. Introduction into macro maker. Overview of basic terms of programing language. Accessing and changing of spreadsheet objects and their properties (application, document, sheet, cell, range). Making of own functions. Manipulation and processing of values from cells or ranges. Using of built-in formulas and functions (absolute and relative references). Event handling. Automated starting of macros. Making of forms and question of data passing between forms and sheets. Dynamic arrays. Text file reading and writing. Handling of exceptions.

Compulsory/Recommended Readings:
- Walkenbach, John: Excel VBA Programming, 3rd Edition, John Wiley & Sons, Hoboken, 2015. ISBN: 9781119077398
- Pitonyak, Adrew: OpenOffice.org Macros Explained, OOME, 3rd edition, 2016.

BIG DATA ANALYSIS

INBGA9935-17

Semester: 6
Type: Lecture / Laboratory
Number of Classes: 2+0+2
Credit: 6
Status: Optional
Assessment: Practical mark
Prerequisites: None
Responsible: Dr. Henrietta Tomán

Topics:
To get familiar with the most important tasks, tools and techniques regarding Big Data analysis. The subject focuses on solving realistic problems, to directly apply the basic concepts and results. The most important topics are the efficient storage, representation and processing of a large amount of data. The students will be familiar with the necessary software tools via realistic case studies. Basic concepts. Data Representation Techniques. Big Data Processing and Storing Architectures. Distributed Processing by MapReduce. Analysing Frequent Data Sets. Locally Sensitive Hashing. Clustering. Dimensionality Reduction. Graph-Based Processing. Analysis of Data Flows. Recommender Systems. Machine Learning for Big Data. Big Data Software. Case Studies.

Compulsory/Recommended Readings:
- Rajaraman, J. D. Ullman: Mining of Massive Datasets, Cambridge University Press, 2011.
- T. White: Hadoop: The Definitive Guide, Yahoo Press, 2012.
- I. Robinson, J. Webber, E. Eifrém: Graph Databases, O'Reilly Media, 2012.
- Y. Bengio: Learning Deep Architectures for AI, Foundations & Trends in Machine Learning, 2009.
- Mining of Massive Datasets, 2nd ed. - http://www.mmds.org/#book, 2015.

DATA VISUALIZATION

INBGA9936-17

Semester: 6
Type: Laboratory
Number of Classes: 0+0+2
Credit: 3
Status: Optional
Assessment: Practical mark
Prerequisites: None
Responsible: Dr. Roland Imre Kunkli

Topics:
Introduction. The history of visualization. Relationship between visualization and other fields. The visualization process. Data foundations. Types of data. Data preprocessing. Human perception and information processing. Perception in visualization. Visualization techniques for spatial, geospatial, time-oriented and multivariate data. Visualization techniques for tree, graphs and networks. Text and document visualization. Interaction concepts and techniques. Designing effective visualizations. Comparing and evaluating techniques. Visualization systems, software and tools. Storytelling. Future directions in visualization.

Compulsory/Recommended Readings:
- Matthew O. Ward, Georges Grinstein, Daniel Keim: Interactive Data Visualization: Foundations, Techniques, and Applications (2nd edition), A K Peters/CRC Press, 2015, ISBN: 978-1482257373
- Katy Borner, David E. Polley: Visual Insights: The Practical Guide to Making Sense of Data, The MIT Press, 2014, ISBN: 978-0262526197
- Cole Nussbaumer Knaflic: Storytelling with Data: A Data Visualization Guide for Business Professionals, Wiley, 2015, ISBN: 978-1119002253
- Stephen Few: Show Me the Numbers: Designing Tables and Graphs to Enlighten (2nd Edition), Analytics Press, 2012, ISBN: 978-0970601971
- Tamara Munzner: Visualization Analysis and Design, A K Peters/CRC Press, 2014, ISBN: 978-1466508910

CORPORATE FINANCE

INBGA9938-17

Semester: 6
Type: Lecture / Seminar
Number of Classes: 2+2+0
Credit: 6
Status: Optional
Assessment: Exam
Prerequisites: INBGA0315-17 (Introduction to finance)
Responsible: Dr. József Mihály Gáll

Topics:
The course gives an introduction to capital market models, including the Markowitz model, CAPM and alternatives and their application, the theory of efficient markets, and tools for project analysis. Finally, the students are introduced to the notion of derivatives, the basics of derivative markets and the pricing of forward and futures contract.

Compulsory/Recommended Readings:
- Brealey R. and Myers S.: Principles of Corporate Finance, 11th Global Edition, McGraw-Hill, 2013.
- Hull, J. C.: Options, Futures and Other Derivatives, 10th edition, Pearson, 2015.

STRATEGIC MANAGEMENT

INBGA9939-17

Semester: 6
Type: Lecture
Number of Classes: 2+0+0
Credit: 3
Status: Optional
Assessment: Exam
Prerequisites: INBGA0103-17 (Introduction to management)
Responsible: Dr. András Nábrádi

Topics:
Course objectives that students are completed the curriculum be aware of the main areas of strategic management, corporate strategic planning methods with, it can be used to achieve skill levels. There are three main parts: 1. strategic planning,2. strategic implementation and 3. strategic controll. Within the subject students became familiar with creating mission and vision statements, external and internal analisys methods, they are known special strategic models like BCG, GE, GSM, CPM, Generic, SPACE, as well as they have information about strategic choices. Using QSPM method they also became familiar with strategic options. In the implemention stage of str. Management they aquire knowledge for planning, organizing, team building and controling part of the subjects.

Compulsory/Recommended Readings:
- Fred R. David, Forest R. David: Strategic management, Concepts and Cases. 15th Edition. Pearson Education Limited, 2015. ISBN: ISBN 10: 1-292-01689-2, ISBN 13: 978-1-292-01689-4
- Meredith E. David, Fred R. David & Forest R. David: The quantitative strategic planning matrix: a new marketing tool. Journal of Strategic Marketing, 2016. http://dx.doi.org/10.1080/0965254X.2016.1148763. ISSN: 0965-254X (Print) 1466-4488

INTRODUCTION TO SAP – DEVELOPER LEVEL

INBGA9940-17

Semester: 6
Type: Laboratory
Number of Classes: 0+0+2
Credit: 3
Status: Optional
Assessment: Practical mark
Prerequisites: None
Responsible: Dr. Anett Rácz

Topics:
Sign into the system, overview and personalizing of user interface. Easy Access menu, SAP help. Structure, layers of the SAP system. Starting and stopping the system, licencing, first steps. Introduction to user management, authorizations, rules, user groups, developer user. Overview of ABAP documentation, starting the ABAP editor. Intorduction into ABAP syntax, variables, types, initialization of variables. First ABAP program. Types of processes, operating modes, scheduling, transport system.

Compulsory/Recommended Readings:
- Schreckenbach, S.: Practical Guide - SAP Administration, Boston: Galileo Press, 2014.
- Moxon, P.: The Beginner's Guide to SAP ABAP, SAPPROUK, 2014.

INTERNATIONAL BUSINESS

INBGA9941-17

Semester: 6
Type: Lecture
Number of Classes: 2+0+0
Credit: 3
Status: Optional
Assessment: Exam
Prerequisites: None
Responsible: Dr. László Erdey

Topics:
Introduction: What is International Business. Globalization of Markets and The Internalization of the Firm. The Cultural Environment of International Business. Ethics, Corporate Social Responsibility, Sustainability and Governance in International Business. Theories of International Trade and Investment. Political and Legal Systems in National Environments. Government Intervention and Regional Economic Integration. Understanding Emerging Markets. The International Monetary and Financial Environment; Financial Management and Accounting in the Global Firm. Strategy and Organization in the International Firm. Global Market Opportunity Assessment. Exporting and Global Sourcing. Foreign Direct Investment and Collaborative Ventures, Licensing, Franchising, and Other Contractual Strategies. Marketing in the Global Firm, Human Resource Management in the Global Firm.

Compulsory/Recommended Readings:
- S. Tamer Cavusgil, Gary Knight, John R. Riesenberger: International Business: The New Realities, Global ed., 4th edition, Pearson, Boston, 2017. ISBN: 978-1-292-15294-3
- Charles W. L. Hill: International Business, McGraw-Hill/Irwin; 9th edition, 2012.

DECISION SUPPORT SYSTEMS

INBGA9942-17

Semester:	6
Type:	Laboratory
Number of Classes:	0+0+2
Credit:	3
Status:	Optional
Assessment:	Practical mark
Prerequisites:	INBGA0208-17 (Mathematics for Business and Economics 2)
Responsible:	Dr. Anett Rácz

Topics:
Main definitions of decision theory, steps of decision processes. Elimination techniques and elementary decision methods. Analytical Hierarchy Process (AHP). Expert Choice and other DSSs based on AHP method. PROMETHEE. DSSs based on PROMETHEE. Decision under uncertainty. Expected value of informations. DSSs for stochastical decision models. Group decision processes (homogeneous, inhomogeneous). Structure of GDSS. Case study.

Compulsory/Recommended Readings:
- Robert T. Clemen: Making Hard Decisions: An Introduction to Decision Analysis, Duxbury Press, 1996.
- A. Ravi Ravindran: Operations Research and Management Science Handbook, CRC Press, 2008.

FUNDAMENTALS OF INFORMATION AND CODING THEORY

INBGA9947-17

Semester: 6
Type: Lecture
Number of Classes: 2+0+0
Credit: 3
Status: Optional
Assessment: Exam
Prerequisites: INBGA0313-17 (Statistics 1)
Responsible: Dr. Sándor Baran

Topics:
General scheme of telecommunication systems. Fundamentals of source coding (uniquely decipherable and prefix codes, efficiency, basic encoding algorithms). Universal source coding, Lempel-Ziv algorithms. Measure of information, entropy, conditional entropy, mutual information and their properties. Channel capacity. Search strategies. Encoding of general information sources, block encoding. Differential entropy. Fundamentals of error correcting coding. Linear codes.

Compulsory/Recommended Readings:
- Cover, Thomas M. and Thomas, Joy A.: Elements of Information Theory. Wiley, 2006.
- Togneri, Roberto and de Silva, Christopher J. S.: Fundamentals of Information Theory and Coding Design. Chapman & Hall/CRC, 2006.
- Ash, Robert B.: Information Theory. Dover Publications, 1990.

INTRODUCTION TO CLOUD TECHNOLOGIES

INBGA9949-17

Semester: 6
Type: Laboratory
Number of Classes: 0+0+2
Credit: 3
Status: Optional
Assessment: Practical mark
Prerequisites: INBGA0212-17 (Programming 1)
Responsible: Dr. Tamás Márton Bérczes

Topics:
During the course, students will be introduced to the following areas:
Essential components of cloud infrastructure, monitoring groups, resources, and resource groups; Computing services, network management, storage and database management services; Virtualization services such as Azure Virtual Machines, Azure Container Instances, or Azure Kubernetes Service; Cloud database services; Storage services such as Azure Blob Storage, Azure Disk Storage, Azure File Storage; Identity management; Control and privacy functions.
Upon completion of the course, students will have the opportunity to earn the "AZ-900: Microsoft Azure Fundamentals" Certificate.

Compulsory/Recommended Readings:
- https://docs.microsoft.com/hu-hu/learn/certifications/exams/az-900

ADVANCED DATA SECURITY

INBGA9943-21

Semester: 7
Type: Lecture
Number of Classes: 2+0+0
Credit: 3
Status: Optional
Assessment: Exam
Prerequisites: INBGA0530-21 (Foundations of Computer Security)
Responsible: Dr. Csanád Bertók

Topics:
Basic concepts, attacks, Symmetric encryptions, Block cipher mode of operation, stream ciphers. Asymmetric encryptions. Cryptosystems based on discrete logarithm problem. Diffie-Hellman key exchange, ElGamal encryption, Digital signatures: RSA, DSA. Hash, MAC functions, Remote entity authentication, Challenge-and-response protocols, Zero-knowledge protocols. Federated identity, Single sign-on, Internet securityi protocols: TLS/SSL protocol, Secure e-mail: PGP és SMIME, Wireless Network Security: Mobile device security, Wi-Fi security, Anonymous communication, TOR. Device and protocol vulnerabilities.

Compulsory/Recommended Readings:
- William Stallings: Cryptography and Network Security, Principle and Practice, 7th edition, 2021.

DIGITAL MARKETING

INBGA9944-17

Semester: 7
Type: Laboratory
Number of Classes: 0+0+2
Credit: 3
Status: Optional
Assessment: Practical mark
Prerequisites: INBGA9921-21 (Marketing)
Responsible: Dr. Anett Rácz

Topics:
Providing useful digital marketing knowledge to students, introducing them to the most important digital marketing tools, the basics of effective online communication, and the most important parts of a digital marketing strategy. Introduction to Digital Marketing. Planning websites. Website development, HTML. Web Analytics. Content Marketing. Search Engine Optimization. Online advertisements. Social Media Marketing. Search Marketing. Email Marketing. Mobile Marketing.

Compulsory/Recommended Readings:
- Lorrie Thomas: Online Marketing, McGraw-Hill 36-Hour Courses, 2011.
- Ira Kaufman, Chris Horton: Digital Marketing: Integrating Strategy and Tactics with Values, A Guidebook for Executives, Managers, and Students, Routledge, 1st edition, 2014.

MANAGEMENT OF VALUE CREATING PROCESS

INBGA9946-17

Semester: 7
Type: Lecture / Seminar
Number of Classes: 2+2+0
Credit: 6
Status: Optional
Assessment: Exam
Prerequisites: INBGA0103-17 (Introduction to management)
Responsible: Dr. Miklós Pakurár

Topics:
The structure of value creating processes. Strategy management. Decision analysis support tools and processes. Quality and quality management. Process capability and statistical process control. Acceptance sampling as decision support analysis. Product design. Service design. Process design and technology. Capacity and facilities planning. Facility location decision support tools. Human resources in the operations management. Work measurement decision analysis support tools. Project management.

Compulsory/Recommended Readings:
- Russell, R. S. - Taylor, B. W. : Operations Management, 8th Edition, Wiley & Suns, INC., ISBN10 1118808908, ISBN13 9781118808900, 2014
- Heizer, J. - Barry R. - Chuck M.: Operations Management: Sustainability and Supply Chain Management (12th Edition), Pearson, ISBN-13: 978-0134130422, ISBN-10: 0134130421, 2016

ETHICAL HACKING I.

INBGA9952-17

Semester:
Type: Laboratory
Number of Classes: 0+0+2
Credit: 3
Status: Optional
Assessment: Practical mark
Prerequisites: INBGA0212-17 (Programming 1)
Responsible: Dr. Csanád Bertók

Topics:
Advanced Linux management: BASH scripting, pipes. Basic principles and tools: bind shell, reverse shell, SSH, netcat, socat, msfvenom. Active information gathering: nmap. Vulnerability scanning and exploit databases: exploit-DG, gtfobins, searchsploit. Buffer overflow attacks: Immunity Debugger, gdb, SUID bits. Automatic and semi-automatic tools: Nessus, LinPEAS, WinPEAS, Metasploit, Nikto.
Hash and password online and offline attacks: hashcat, john the ripper, THC hydra, wpscan, Burp Suite.
Network analysis and exploitation: Wireshark, aircrack-ng, dirbuster, gobuster.

Compulsory/Recommended Readings:
- ·Ric Messier – CEH v10 Certified Ethical Hacker Study Guide, ISBN-13: 978-1119533191
- ·Peter Kim – The Hacker Playbook (1,2,3): Practical Guide to Penetration Testing

BLOCKHAIN TECHNOLOGY

INBGA9953-17

Semester:
Type: Lecture
Number of Classes: 2+0+0
Credit: 3
Status: Optional
Assessment: Exam
Prerequisites: None
Responsible: Dr. Andrea Pintér-Huszti

Topics:
The primary aim of the course is to help students learn the basics of blockchain technology.

Week 1: Introduction to the basics of the blockchain - the history of the blockchain, the properties of the blockchain, the CAP theorem, the problem of Byzantine generals
Week 2: The cryptographic background of the blockchain - hash functions
Week 3: Blockchain structure and operation
Week 4: Blockchain transactions
Week 5: Blockchain consensus mechanisms
Week 6: Blockchain related applications - cryptocurrencies
Week 7: Blockchain related applications - contracts
Week 8: Technical challenges of the blockchain, suggestions and improvements
Week 9: Case studies: Ripple, WeTrade, Santander, Lo3 energy, Smartresume
Week 10: Blockchain-based applications
Week 11: The future of blockchains
Week 12: End-term Test

Compulsory/Recommended Readings:

- Nakamoto, Satoshi. "Re: Bitcoin P2P e-cash paper." The Cryptography Mailing List (2008).
- Swan, Melanie. Blockchain: Blueprint for a new economy. " O'Reilly Media, Inc.", 2015.
- Lacity, Mary C. Blockchain foundations: for the internet of value. Epic Books, 2020.

INTRODUCTION TO THE AWS CLOUD

INBGA9958-17

Semester:
Type: Laboratory
Number of Classes: 0+0+2
Credit: 3
Status: Optional
Assessment: Practical mark
Prerequisites: None
Responsible: Dr. Ádám Tóth

Topics:
In this course, students will learn the basic concepts of the AWS cloud; the AWS pricing philosophy; the global infrastructure components of AWS; and the security and compliance measures of the AWS cloud, including AWS identity and access management (IAM). You will learn how to build an AWS virtual private cloud; the use of Amazon Elastic Compute Cloud (EC2), AWS Lambda, and AWS Elastic Beanstalk; the differences between Amazon S3, Amazon EBS, Amazon EFS, and Amazon S3 Glacier; and the use of AWS database services (Amazon Relational Database Service (RDS), Amazon DynamoDB, Amazon Redshift, and Amazon Aurora). Students learn the principles of the AWS Cloud architecture and key concepts related to elastic load balancing (ELB), Amazon CloudWatch and auto scaling.
This course helps prepare students for the AWS Cloud Practitioner certification exam.

Compulsory/Recommended Readings:
- https://docs.aws.amazon.com/
- https://aws.amazon.com/whitepapers/
- https://d0.awsstatic.com/whitepapers/aws-overview.pdf
- https://d1.awsstatic.com/whitepapers/AWS_Cloud_Best_Practices.pdf
- https://d0.awsstatic.com/whitepapers/aws_pricing_overview.pdf
- https://media.amazonwebservices.com/AWS_TCO_Web_Applications.pdf

NETWORK AND SYSTEM SECURITY

INBGA9959-21

Semester:
Type: Laboratory
Number of Classes: 0+0+2
Credit: 3
Status: Optional
Assessment: Practical mark
Prerequisites: INBGA0106-17 (Operating systems)
Responsible: Dr. Csanád Bertók

Topics:
Description of blue teaming, basic tasks, objectives, tools. Demonstartion of virtualization techniques (Hypervisors, LXC, VM). Creating a virtual environment packed with typical blue teaming tools: firewalls, routers, load balancing. Demonstration of frequent host-based firewall settings, port forwarding. Basic concepts and creation of DMZ. Deployment of reverse proxy, VPN, Radius server. Deployment of different HIDS, NIDS and other monitoring tools: SNMP and Agent-based monitoring. Creation of SSH Bastion hosts, limiting access. Basics of permissions, logging and log evaluation.

Compulsory/Recommended Readings:
- Don Murdoch: Blue Team Handbook: SOC, SIEM, and Threat Hunting (V1.02): A Condensed Guide for the Security Operations Team and Threat Hunter
- Alan White & Ben Clark: Blue Team Field Manual (BTFM) (RTFM)

ETHICAL HACKING 2.

INBGA9960-21

Semester:
Type: Laboratory
Number of Classes: 0+0+2
Credit: 3
Status: Optional
Assessment: Practical mark
Prerequisites: INBGA9952-17 (Ethical hacking I.)
Responsible: Dr. Csanád Bertók

Topics:

- Basics of container security
  - Capabilities, docker escape, privilegized containers
- Log poisoning
- Exploitation of CRON jobs and services
- Windows security
  - Exploitation of permissions
  - Service-misconfigurations
  - SMB, NFS security
- „Lateral movement"
  - SOCKS proxy
  - sshuttle
  - Pivoting
  - SSH tunneling
- Network attacks
  - DHCP spoofing
  - ARP poisoning
  - DNS spoofing

Compulsory/Recommended Readings:

- Peter Kim, The Hacker Playbook 2: Practical Guide To Penetration Testing
- Georgia Weldman, Penetration Testing: A Hands-On Introduction to Hacking
- Network Basics for Hackers: How Networks Work and How They Break

DEVSECOPS

INBGA9961-21

Semester:
Type: Laboratory
Number of Classes: 0+0+2
Credit: 3
Status: Optional
Assessment: Practical mark
Prerequisites: INBGA0106-17 (Operating Systems)
Responsible: Dr. Csanád Bertók

Topics:

- Basics of containerization (docker, docker compose)
  - Creation of Docker files and
  - Docker compose files
  - Container-security
- „Container orchestration" with Kubernetes
  - Creation of deployments, manifests, services, etc.
  - Configuration of Load balancing and
  - Ingress
  - Security problems regarding „container orchestration"
- Usage of GitLab for „GitOps"
  - Deployment of GitLab runners
  - Creation of a CI/CD pipeline
  - Token usage
  - Security and access control
- Monitoring with Prometheus + Grafana
- Security problems: backups, SIEM tools, log analysis

Compulsory/Recommended Readings:

- https://github.com/DevOps-Projects-Ideas/DevOps-Books